

## 299-W22-33 (A7852) Log Data Report

### Borehole Information:

<b>Borehole:</b> 299-W22-33 (A7852)			<b>Site:</b> 216-S-7 Crib			
<b>Coordinates</b> (WA State Plane)		<b>GWL (ft)<sup>1</sup>:</b> Not deep enough	<b>GWL Date:</b> 3/25/2004			
<b>North</b>	<b>East</b>	<b>Drill Date</b>	<b>TOC<sup>2</sup> Elevation</b>	<b>Total Depth (ft)</b>	<b>Type</b>	
134,168.02 m	567,154.63 m	June 1966	208.18 m	212	Cable Tool	

### Casing Information:

<b>Casing Type</b>	<b>Stickup (ft)</b>	<b>Outer Diameter (in.)</b>	<b>Inside Diameter (in.)</b>	<b>Thickness (in.)</b>	<b>Top (ft)</b>	<b>Bottom (ft)</b>
Welded steel	+3.35	6 5/8	6	5/16	0	212
Welded steel	0	4	unknown	unknown	3.35	204.35
The logging engineer measured the casing stickup using a steel tape. A caliper was used to determine the outside casing diameter. Inside casing diameter was measured with a steel tape. All measurements were rounded to the nearest 1/16 in. Casing bottom depth is reported from Ledgerwood (1993). Casing thickness was calculated.						

### Borehole Notes:

Borehole coordinates, elevation, and borehole construction information are from measurements by Stoller field personnel, HWIS<sup>3</sup>, and Ledgerwood (1993). Zero reference is the top of the 6-in. casing.

### Logging Equipment Information:

<b>Logging System:</b>	Gamma 1G	<b>Type:</b>	35% HPGe (34TP10967A)
<b>Calibration Date:</b>	1/2004	<b>Calibration Reference:</b>	GJO-2004-597-TAC
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

<b>Logging System:</b>	Gamma 1C	<b>Type:</b>	High Rate Detector
<b>Calibration Date:</b>	04/2003	<b>Calibration Reference:</b>	GJO-2003-429-TAC
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

### Spectral Gamma Logging System (SGLS) Log Run Information:

<b>Log Run</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Date	03/25/04	03/25/04	03/29/04	03/29/04	03/29/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	211.89	211.5	118.5	52.5	37.5
Finish Depth (ft)	211.89	117.5	53.5	38.5	28.5
Count Time (sec)	200	200	200	20	200
Live/Real	R	R	R	R	R

Log Run	1	2	3	4	5
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	N/A <sup>4</sup>	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AG057CAB	AG057CAB	AG058CAB	AG058CAB	AG058CAB
Start File	AG057000	AG057001	AG058000	AG058066	AG058081
Finish File	AG057000	AG057095	AG058065	AG058080	AG058090
Post-Verification	AG057CAA	AG057CAA	AG058CAA	AG058CAA	AG058CAA
Depth Return Error (in.)	N/A	-1	N/A	N/A	N/A
Comments	Sonde tip is just touching bottom of borehole.	Fine-gain adjustment made after files -002 and -005.	No fine-gain adjustment.	High rate zone dead time > 40 %. Count time change.	No fine-gain adjustment.

Log Run	6	7	8 / Repeat		
Date	03/29/04	03/29/04	03/29/04		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	27.5	19.5	19.5		
Finish Depth (ft)	20.5	3.5	3.5		
Count Time (sec)	20	200	200		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	1.0		
ft/min	N/A	N/A	N/A		
Pre-Verification	AG058CAB	AG058CAB	AG058CAB		
Start File	AG058091	AG058099	AG058116		
Finish File	AG058098	AG058115	AG058132		
Post-Verification	AG058CAA	AG058CAA	AG058CAA		
Depth Return Error (in.)	N/A	-1	0		
Comments	High rate zone - dead time > 40 %. Count time change.	No fine-gain adjustment.	Repeat section.		

### **High Rate Logging System (HRLS) Log Run Information:**

Log Run	1	2	3	4	5
Date	03/30/04	03/30/04	03/30/04	03/30/04	03/30/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	54.5	48.5	39.5	32.5	28.5
Finish Depth (ft)	49.5	40.5	38.5	29.5	21.5
Count Time (sec)	300	100	300	300	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AC095CAB	AC095CAB	AC095CAB	AC095CAB	AC095CAB
Start File	AC095000	AC095006	AC095015	AC095017	AC095021
Finish File	AC095005	AC095014	AC095016	AC095020	AC095028
Post-Verification	AC095CAA	AC095CAA	AC095CAA	AC095CAA	AC095CAA
Depth Return Error (in.)	N/A	N/A	N/A	N/A	N/A

Log Run	1	2	3	4	5
Comments	No fine-gain adjustment.	None	None	No fine-gain adjustment.	None

Log Run	6	7 / Repeat			
Date	03/30/04	03/30/04			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	20.5	27.5			
Finish Depth (ft)	19.5	24.5			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AC095CAB	AC095CAB			
Start File	AC095029	AC095031			
Finish File	AC095030	AC095034			
Post-Verification	AC095CAA	AC095CAA			
Depth Return Error (in)	N/A	-1			
Comments	No fine-gain adjustment.	Repeat section.			

### **Logging Operation Notes:**

Zero reference was top of the 6-in. casing. Logging was performed without a centralizer installed on the sonde. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (<sup>40</sup>K, <sup>238</sup>U, and <sup>232</sup>Th) verifier with serial number 118. HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the <sup>137</sup>Cs verifier with serial number 1013. Maximum logging depth achieved was 211.89 ft.

### **Analysis Notes:**

<b>Analyst:</b>	Sobczyk	<b>Date:</b>	4/05/04	<b>Reference:</b>	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. All of the verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 1.4 percent lower and 4.2 percent higher at the end of the day.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. The post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G1GJan04.xls [SGLS] and G1CApr03.xls [HRLS]). Zero reference was the top of the 6-in. casing. Based on Ledgerwood (1993), the casing configuration was assumed to be a string of 6-in. casing with a thickness of 5/16 in. to total logging depth (211.89 ft) and a string of 4-in. casing with a thickness of 0.237 in. to a log depth of 204.3 ft. The 6-in. casing thickness was measured by the logging engineer. A casing thickness of 0.237 in. was assumed for the 4-in. casing. This thickness is the published

value for ASTM schedule-40 steel pipe, a commonly used casing material at Hanford. Where more than one casing exists at a depth, the casing correction is additive (e.g., the correction for both 6-in. and 4-in. casing would be  $0.313 + 0.237 = 0.55$ ). A water correction was not required.

Using the SGLS, dead time greater than 40 percent was encountered in the intervals from 21.5 to 29.5 ft and 39.5 to 53.5 ft. Data from these regions are considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent. SGLS and HRLS dead time corrections were applied when dead time surpassed 10.5 percent.

### **Log Plot Notes:**

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The  $^{214}\text{Bi}$  peak at 1764 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations on the combination plot rather than the  $^{214}\text{Bi}$  peak at 609 keV because it exhibited slightly higher net counts per second.

### **Results and Interpretations:**

$^{137}\text{Cs}$  was the only man-made radionuclide detected in this borehole.  $^{137}\text{Cs}$  was detected throughout almost the entire length of the borehole. Concentrations ranged from the MDL (0.2 pCi/g) to 300,000 pCi/g. The maximum concentration of  $^{137}\text{Cs}$  was measured at 27.5 ft.

Recognizable changes in the KUT logs occurred in this borehole. Grout is present between the casings and outside the 6-in. casing from the surface to 200 ft and masks the natural KUT response. Changes of 4 pCi/g or more in apparent  $^{40}\text{K}$  concentrations occur at approximately 68, 147, 195, and 204 ft. Changes in  $^{232}\text{Th}$  concentrations of approximately 0.4 pCi/g occur at 68, 135, and 147 ft. Between 135 and 147 ft, the fine-grained member of the Cold Creek Unit (formerly known as the Early Palouse Soil) is shown by an increase in  $^{232}\text{Th}$  (0.4 pCi/g). There is an approximately 5 pCi/g decrease in  $^{40}\text{K}$  concentrations in the interval between 147 and 155 ft. Based on low  $^{40}\text{K}$  concentrations, the carbonate-rich paleosols of the Cold Creek Unit are interpreted as being between 147 and 155 ft.

Gross gamma logs from Fecht et al. (1977) (attached) indicate that the sediments surrounding this borehole contained significant amounts of man-made gamma radiation from 1968 through at least 1976. The log from 2/16/68 appears to detect relatively high gamma activity to the total depth of the borehole. The log from 5/13/76 appears to detect relatively high gamma activity in the interval from 16 ft (5 m) to 131 ft (40 m) and the highest activities occurred in the interval from 20 ft (6 m) to 52 ft (16 m). The SGLS detected  $^{137}\text{Cs}$  at concentrations greater than 1,000 pCi/g in the intervals from 21 to 32 ft and 39 to 53 ft.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS and SGLS data.  $^{137}\text{Cs}$  (662 keV) concentrations are comparable between the repeat and original log runs for the HRLS and SGLS. The natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs.

Three boreholes, 299-W22-12, 299-W22-13, and 299-W22-14, are located immediately outside the crib boundary, on the west, south, and east. Analyses of data from boreholes 299-W22-32 and 299-W22-33 indicate that zones of very high gamma activity are encountered between depths of 21 to 60 ft and 21 to 54 ft, respectively. Evaluation of historical gross gamma logs from 299-W22-12, 299-W22-13, and

299-W22-14 indicate similar gamma activity profiles in these wells. It appears that gamma activity may have been higher in the boreholes outside the crib. In particular, early logs in boreholes 299-W22-13 and 299-W22-14 appear to indicate detector saturation to depths of at least 100 meters. It is likely that breakthrough to groundwater occurred at this site prior to 1963. It is recommended that these boreholes be logged as soon as possible, since they will provide important information on migration of contaminants from this crib. All of these boreholes are on the most recent list of holes to be decommissioned, beginning in October.

### **References:**

Fecht, K.R., G.V. Last, and K.R. Price, 1977. *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*, ARH-ST-156, Atlantic Richfield Hanford Company, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-West Resource Protection Wells*, WHC-SD-ER-TI-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

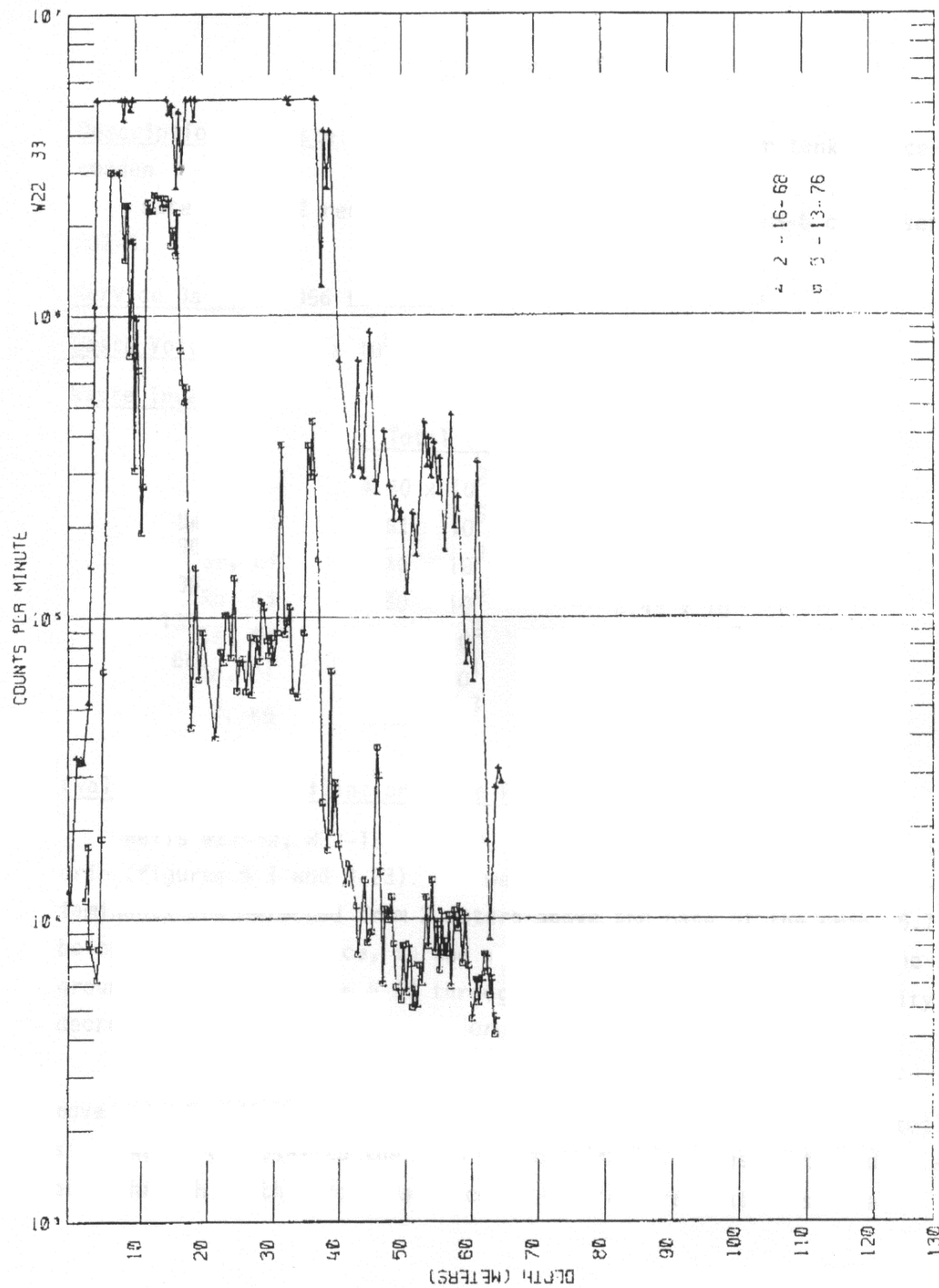
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<sup>1</sup> GWL – groundwater level

<sup>2</sup> TOC – top of casing

<sup>3</sup> HWIS – Hanford Well Information System

<sup>4</sup> N/A – not applicable

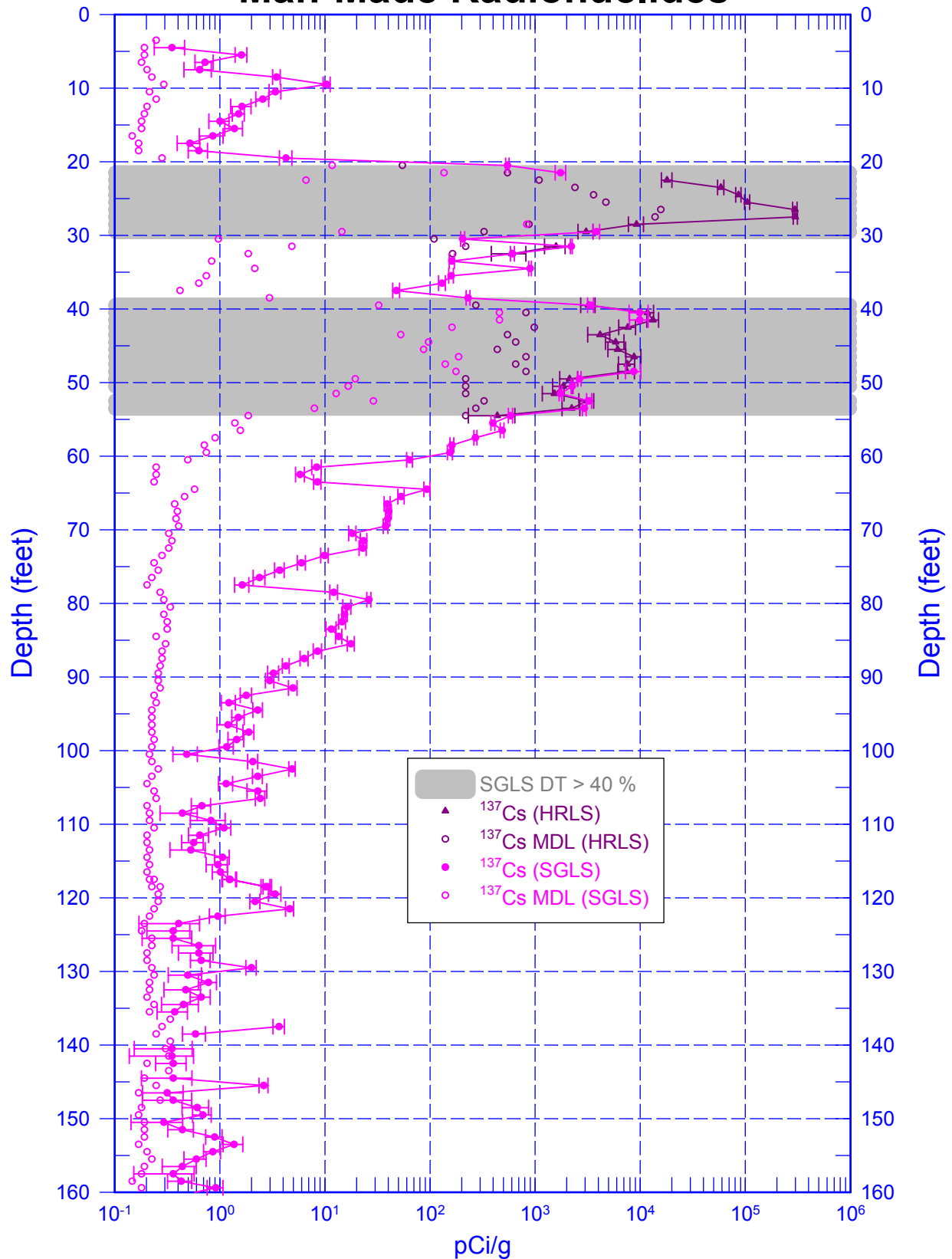


from Fecht et al. (1977)

*Scintillation Probe Profiles for Borehole 299-W22-33, Logged on 2/16/68 and 5/13/76*

# 299-W22-33 (A7852)

## Man-Made Radionuclides

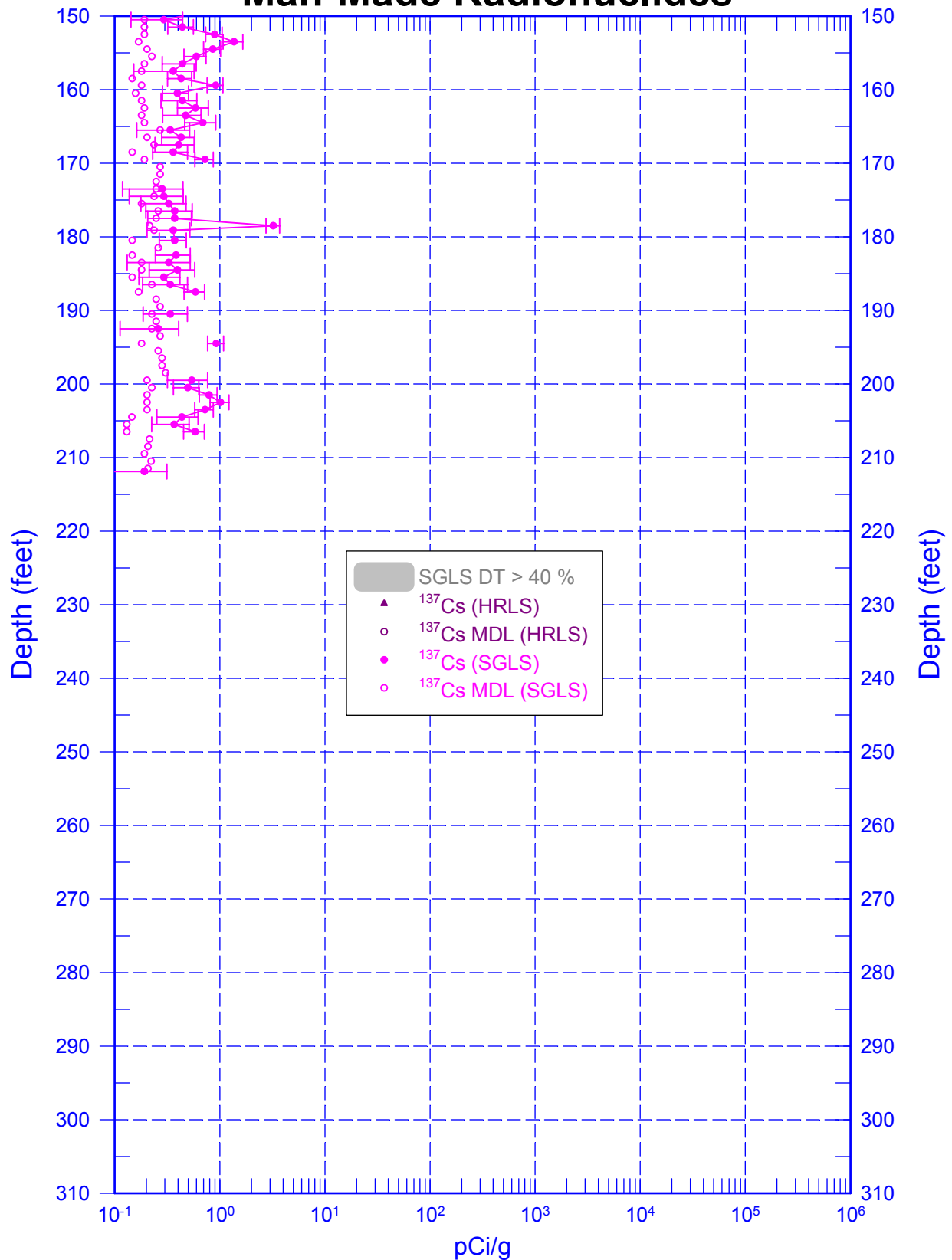


Zero Reference = Top of Casing

Date of Last Logging Run  
3/30/2004

# 299-W22-33 (A7852)

## Man-Made Radionuclides



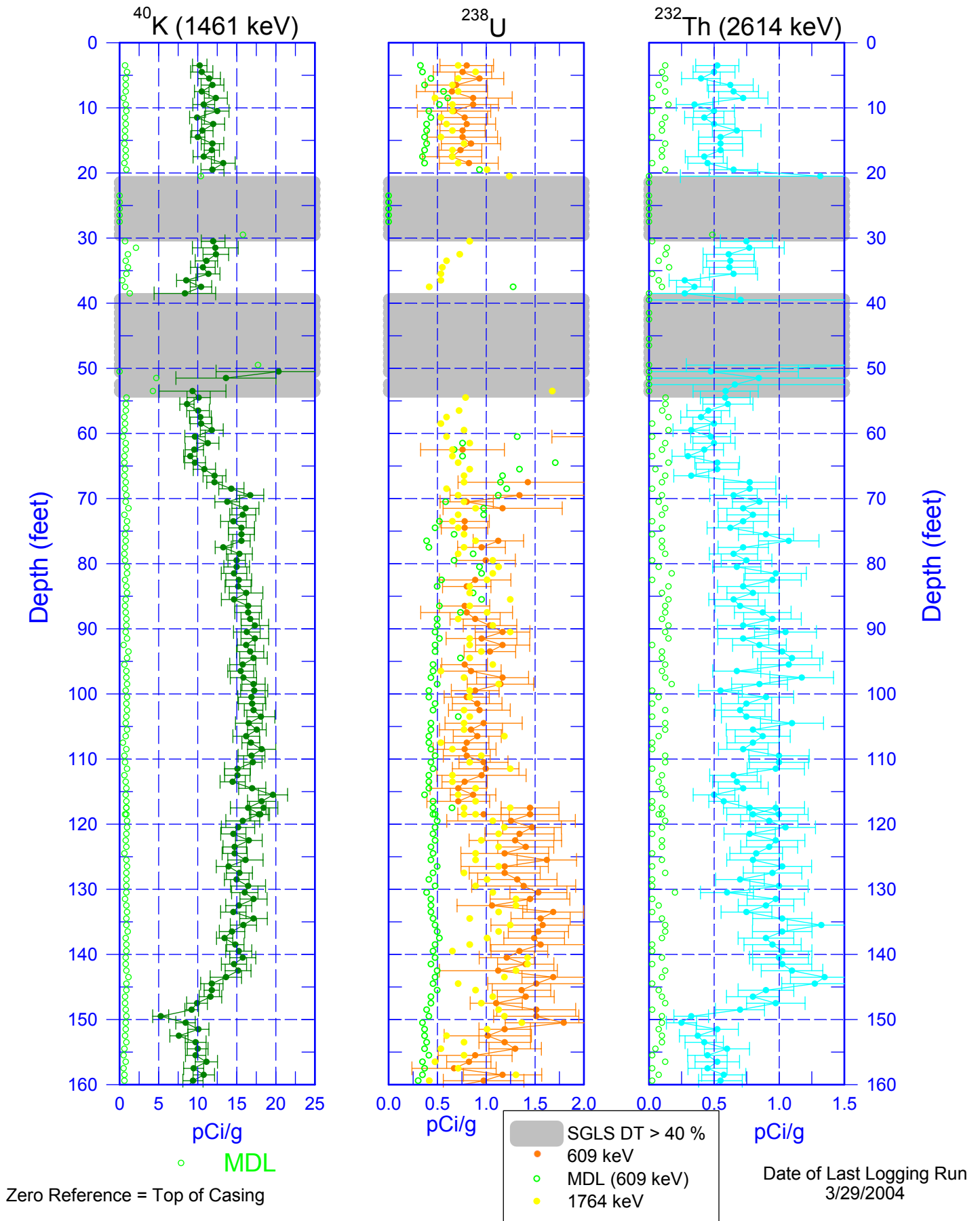
Zero Reference = Top of Casing

Date of Last Logging Run  
3/30/2004



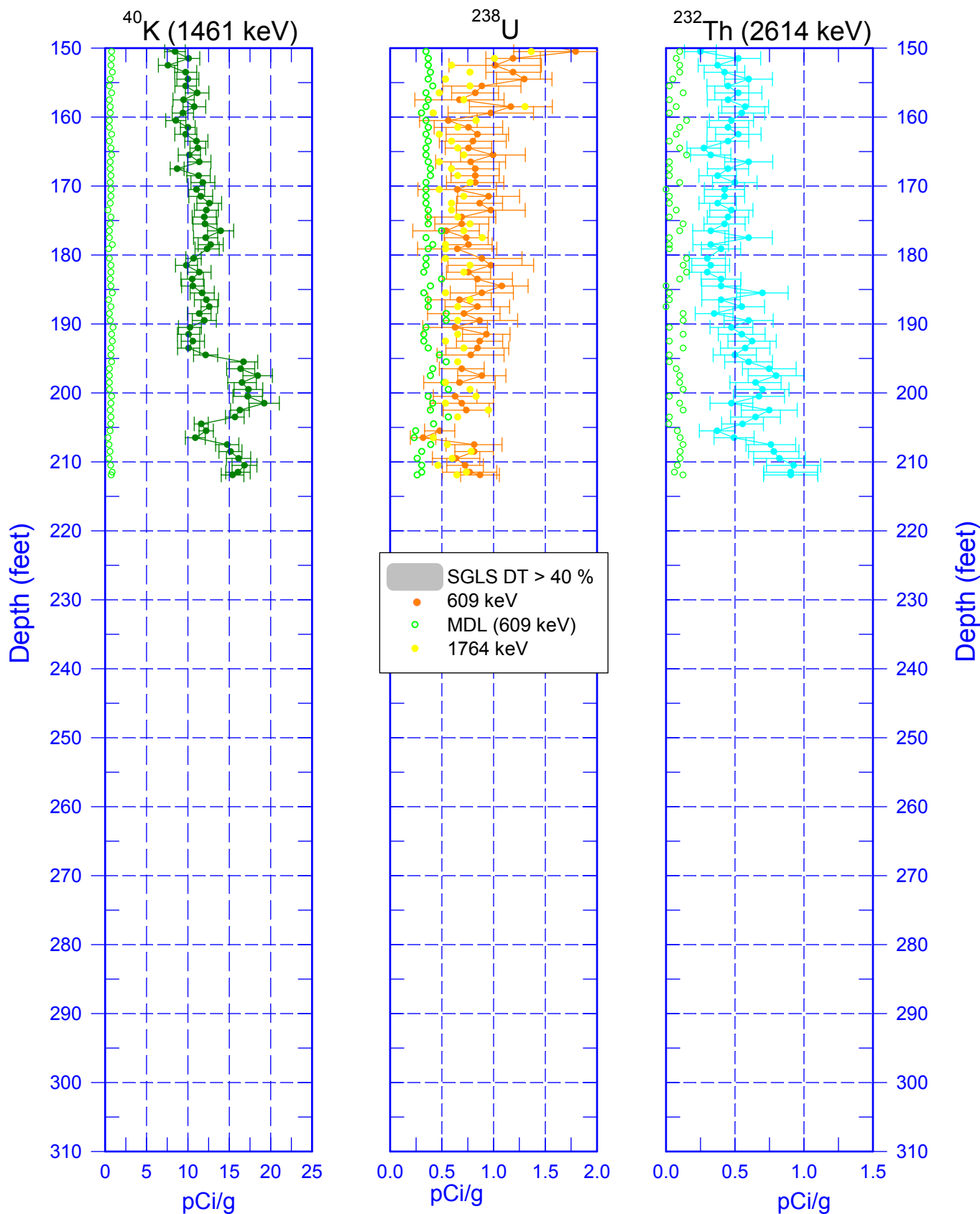
# 299-W22-33 (A7852)

## Natural Gamma Logs

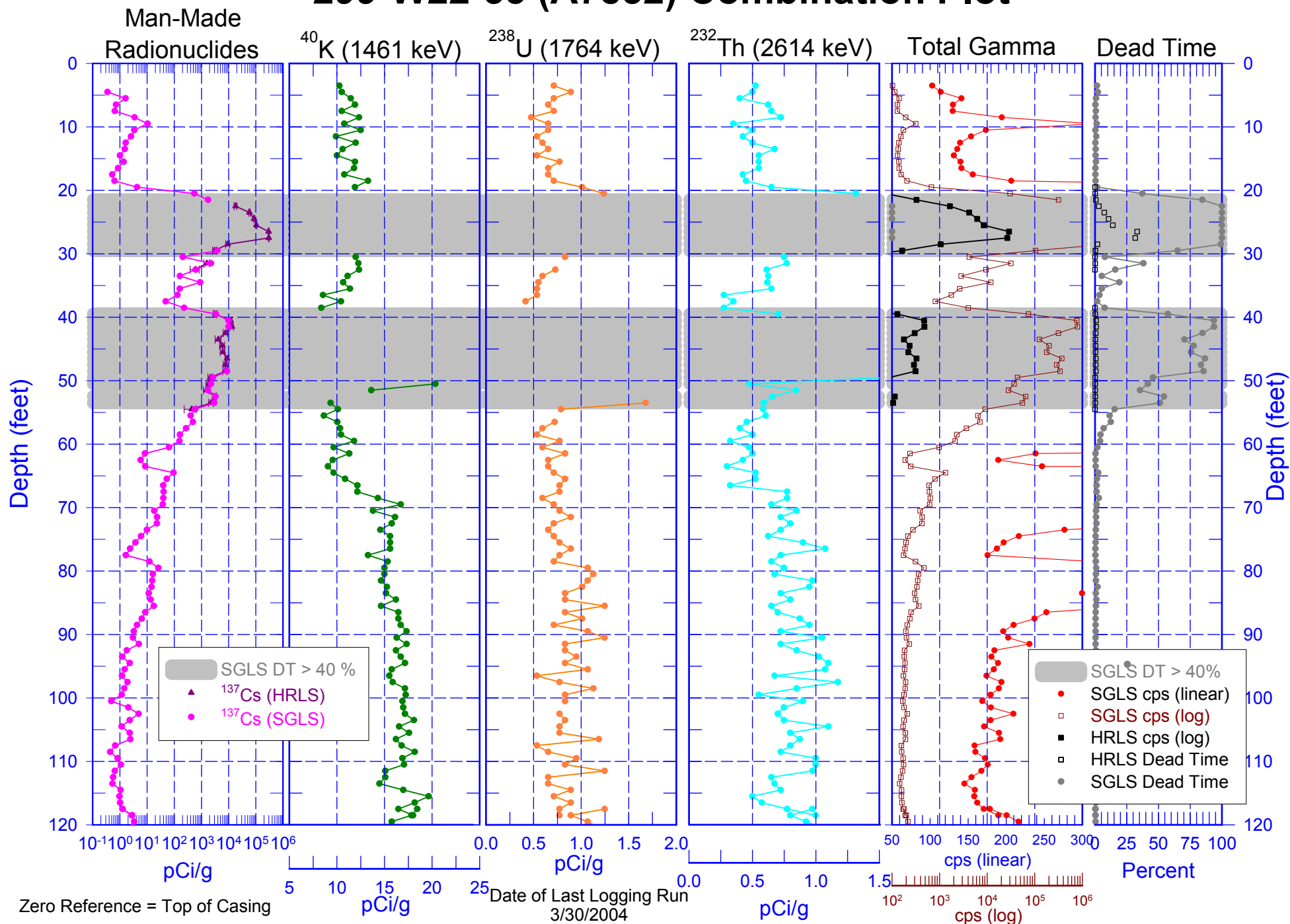


# 299-W22-33 (A7852)

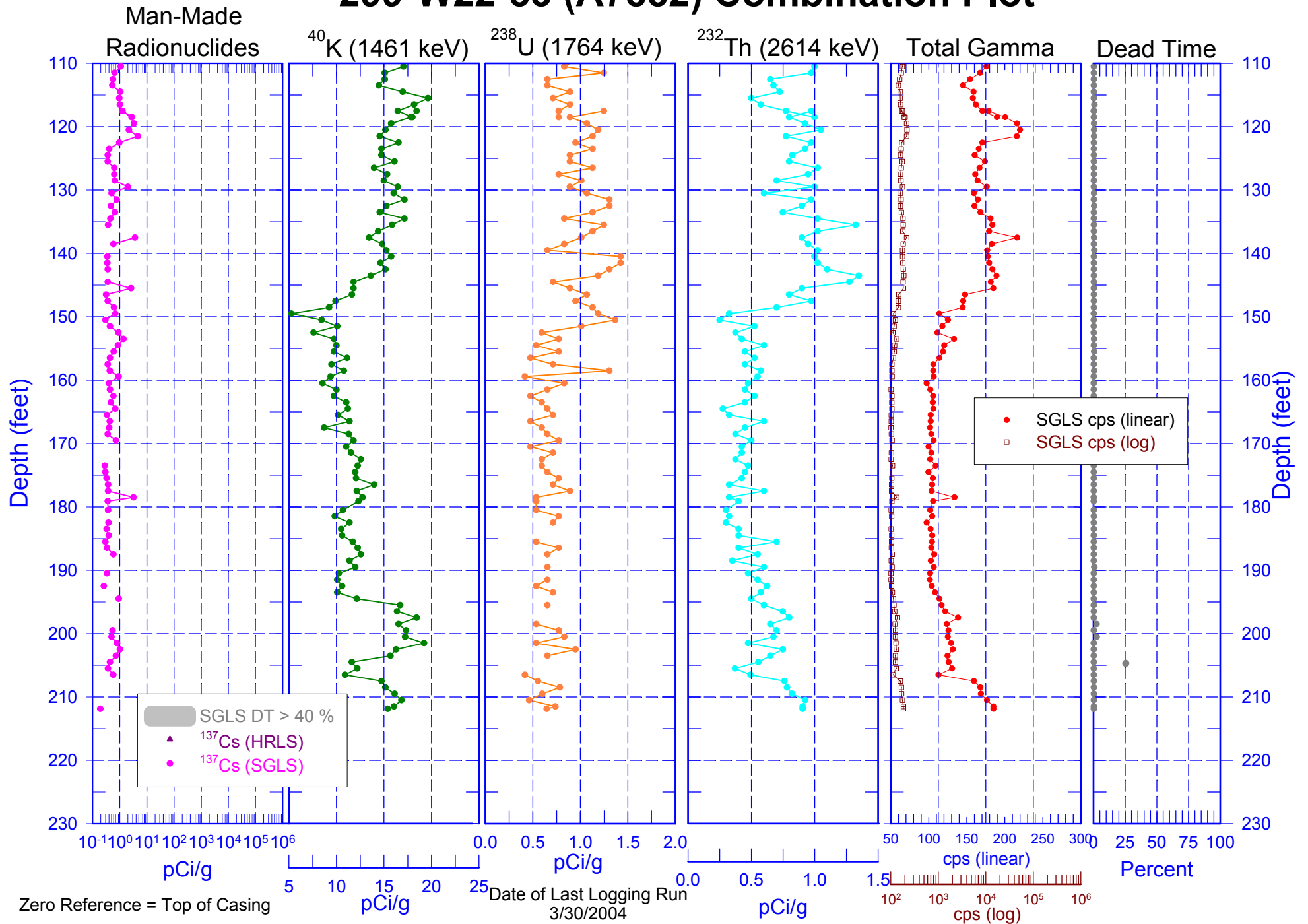
## Natural Gamma Logs



# 299-W22-33 (A7852) Combination Plot

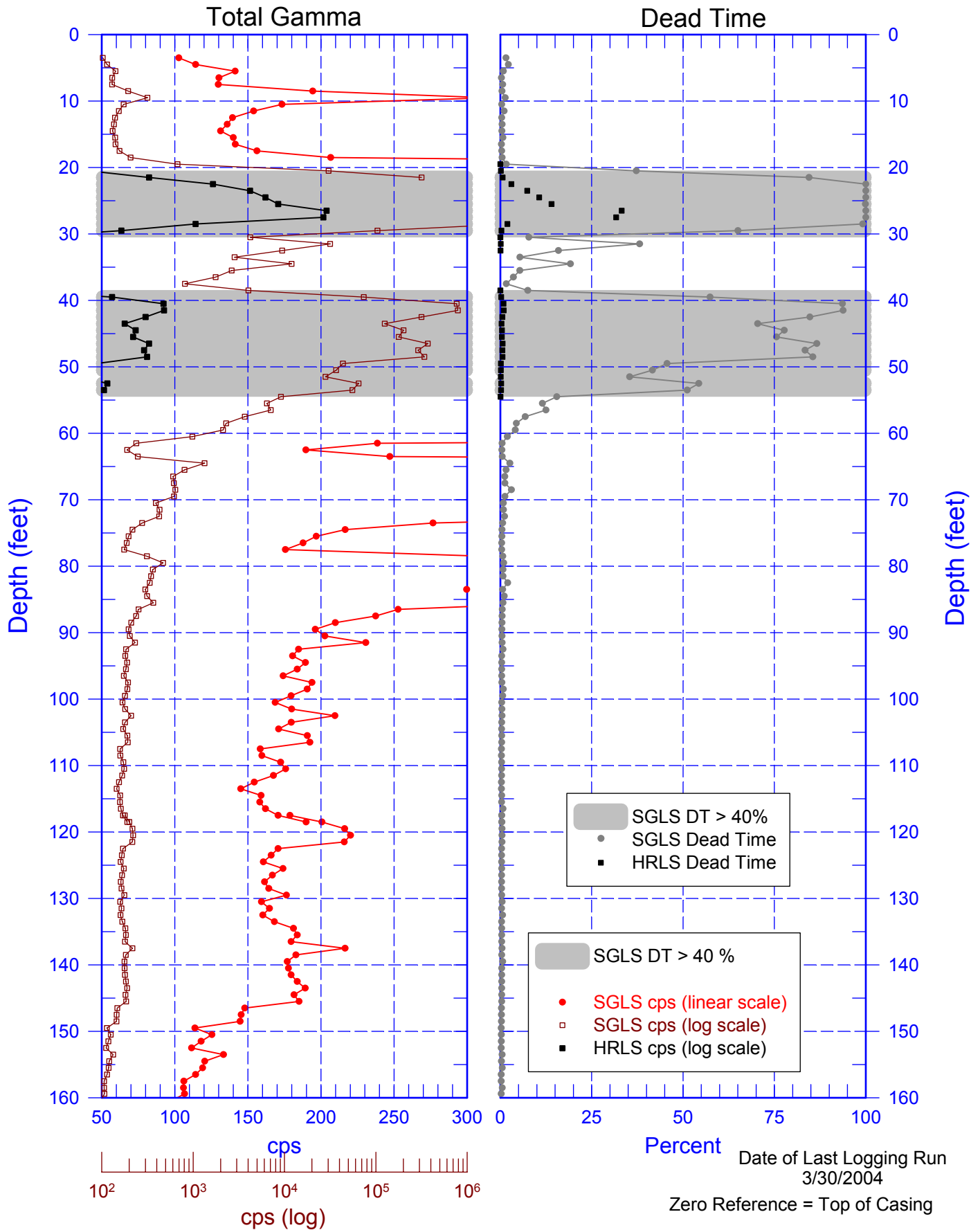


## 299-W22-33 (A7852) Combination Plot



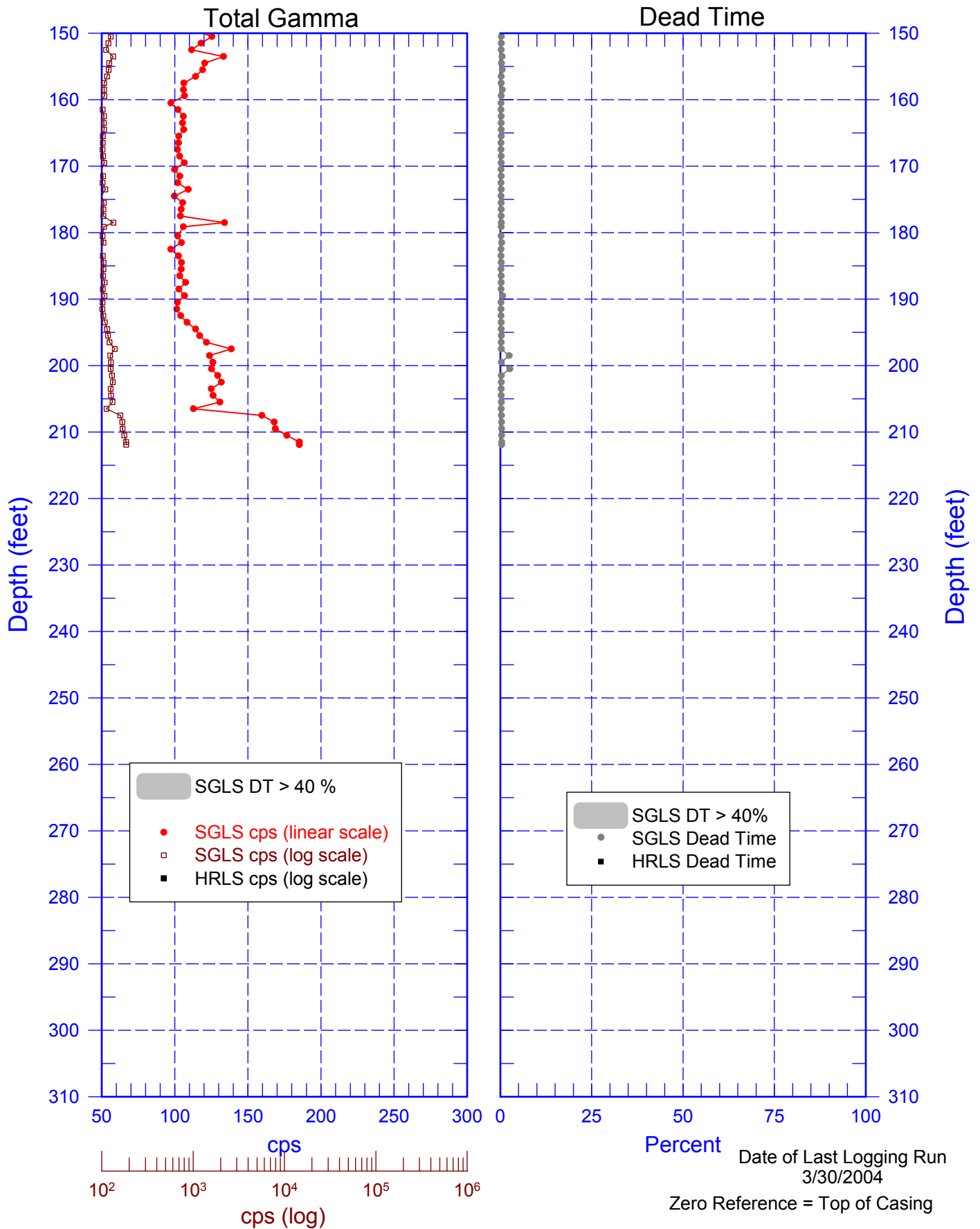
# 299-W22-33 (A7852)

## Total Gamma & Dead Time



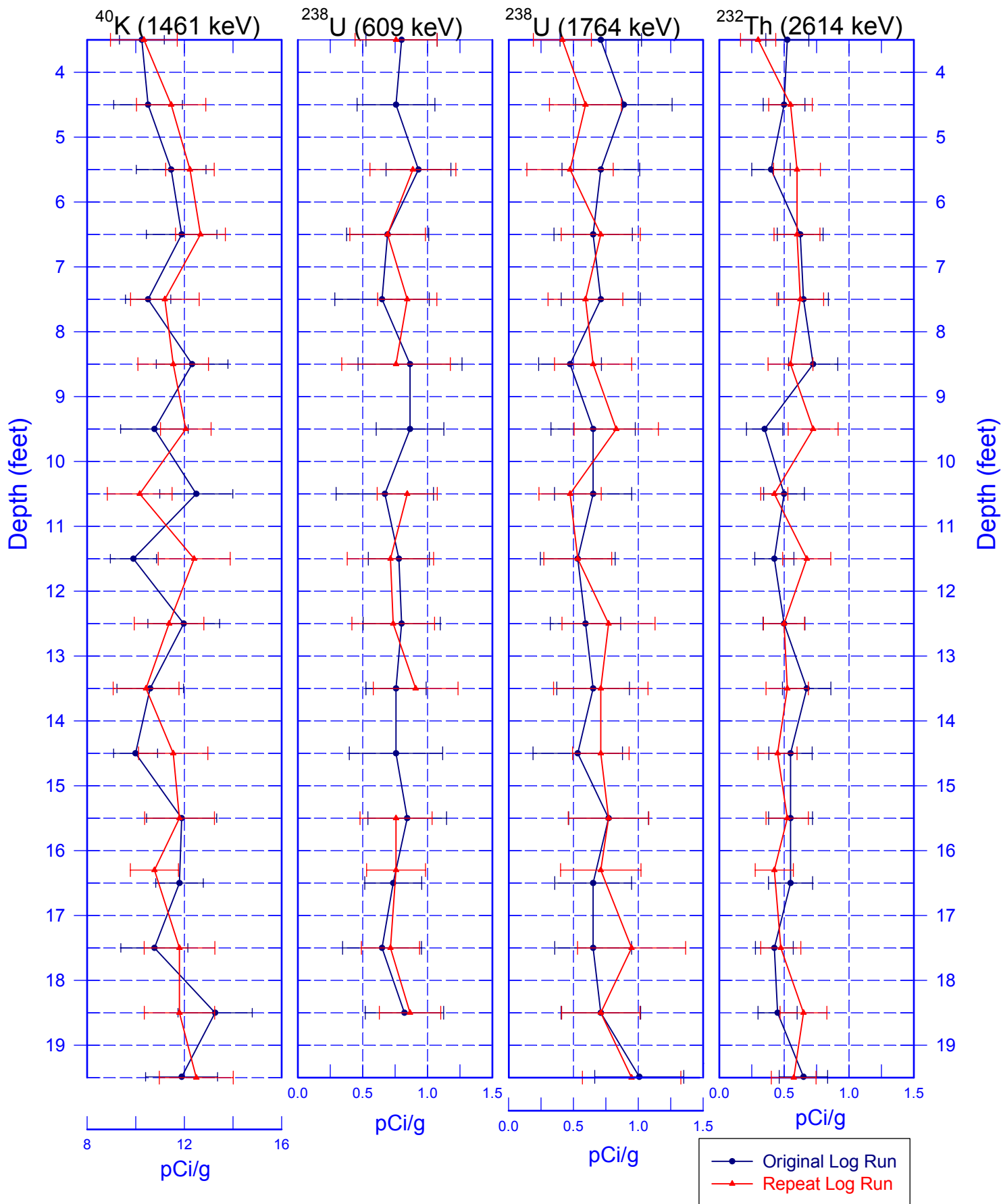
# 299-W22-33 (A7852)

## Total Gamma & Dead Time



# 299-W22-33 (A7852)

## Rerun of Natural Gamma Logs (19.5 to 3.5 ft)



# 299-W22-33 (A7852)

## Rerun of $^{137}\text{Cs}$

